CABLE-LESS INTERCONNECT ARCHITECTURE FOR EFFECTING BLIND COUPLING OF DIPLEXER TO RADIO TRANSCEIVER

FIELD OF THE INVENTION

The present invention relates in general to communication systems and components therefor and is particularly directed to a new and improved interconnect arrangement for effecting a cable-less blind coupling of a diplexer to a transceiver of an associated radio, such as that used for digital telecommunications, irrespective of a selected one of a plurality of available frequency plans for the radio.

BACKGROUND OF THE INVENTION

Although legacy (copper) wirelines have served as a principal information transport backbone for a variety of telecommunication networks, the continued development of other types of signal transport technologies, particularly those capable of relatively wideband service, including coaxial cable, fiber optic and wireless (e.g., radio) systems, have resulted in a multiplicity of systems that serve a diversity of environments and users. A particular advantage of wireless service is the fact that it is very flexible and not limited to serving only customers having access to

existing or readily installable cable plants. Moreover, there are many environments, such as, but not limited to portable data terminal equipments (DTEs), where a digital wireless subsystem may be the only practical means of communication.

In order to provide digital communication service, the wireless (radio) subsystem must be interfaced with an existing digital network's infrastructure, which typically includes legacy wireline links (that may contain one or more repeaters) coupled to an incumbent service provider site. In addition, the digital radio site which provides access to the wireline must also provide a source of electrical power. In many environments, the required power supply is either not readily available, or its cost of installation is prohibitively expensive.

The invention described ~~in co-pending~~ U.S. Patent Application, Serial No. 09/771,370, filed January 25, 2001, by Eric Rives et al, entitled: "Loop-Powered T1 Radio" (hereinafter referred to as the '370 application), assigned to the assignee of the present application and the disclosure of which is incorporated herein, is directed to a loop-powered digital (T1) radio architecture that is configured to solve this lack of available local power problem by extracting power from the line. This effectively eliminates having to locate the radio where a separate dedicated power supply is either available or can be installed, so that the radio

may used practically anywhere access to a powered wireline is available.

The radio itself may comprise a blue tooth (spread spectrum) digital radio associated with portable digital terminal equipment, such as a notebook computer, or a remote digital radio that terminates a separate powered wireline. Power for operating the radio is extracted from the loop via a line interface coupled to tip and ring portions of respective transmit and receive segments of a powered T1 wireline link. The line interface contains a DC-DC converter to scale down the span voltage to standard voltages used to power the radio's digital signaling and transceiver electronics.

As diagrammatically illustrated in Figure 1, the radio proper has a transceiver 10 (e.g. one that is 'blue tooth'-compatible), which performs modulation and up-conversion of baseband signals supplied from a data pump (T1 framer chip) 12 to an FCC-conformal band RF signal (e.g., a 2-6 GHz spread spectrum signal), for application via a first section of cable plant 14 to a first transceiver port 21 of a diplexer 20. The diplexer 20 has an (N-type) antenna port 23 coupled to an associated radio antenna 25. A second transceiver port 22 of the diplexer 20 is coupled via a second section of cable plant 15 to a receiver section of the transceiver, wherein the received RF signal is down-converted and demodulated to baseband for application to the data pump.

The respective transmit and receive frequencies interfaced by the diplexer 20 with the antenna 25 are prescribed by one of two complementary frequency plans, the other of which is employed by a companion radio at a remote site.

To facilitate selectivity of either frequency plan, the radio transceiver - diplexer arrangement is preferably configured in the manner described in the U.S. Patent to P. Nelson et al, No. 6,178,312, issued January 23, 2001, entitled: "Mechanism for Automatically Tuning Transceiver Frequency Synthesizer to Frequency of Transmit/Receiver Fitler" (hereinafter referred to as the '312 Patent), assigned to the assignee of the present application and the disclosure of which is incorporated herein. As shown and described therein, the frequency plan (transmit/receive frequency pair) of the radio is defined by selectively coupling the appropriate one of two diplexer ports of a diplexer unit to the transmit port of the transceiver and the other diplexer port to the receive port of the transceiver. (At the far end or remote site the diplexer to transceiver port connections would be reversed.)

Because the sections of RF cable through which these diplexer-to-transceiver connections are made are lossy (e.g., 1-2 dB of insertion loss), special purpose, relatively fragile, and take up space within the radio's housing, they are installed by a skilled technician during assembly of the radio in accordance with the

intended frequency plan of the equipment. As a consequence, should it be necessary to change the frequency plan of the radio in the field, it is customary practice to 'swap out' both units at opposite ends of the radio link, and the radios returned to the equipment supplier for refurbishment.

SUMMARY OF THE INVENTION

In accordance with the present invention, this cable connectivity problem is effectively obviated by providing each of the radio transceiver and the diplexer with respective pairs of blind-mating RF transmission channel and receiver channel connectors. Each pair of RF connectors is supported in a prescribed (fixed) spatial orientation that provides for blind-mating RF connectivity therebetween for either of two orientations and translation of the diplexer relative to the transceiver.

For this purpose, as in the radio architecture of Figure 1 described above, the respective transmit and receive frequencies interfaced by the diplexer with an antenna are selected by one of two complementary frequency plans, the other of which is employed by a companion radio at a remote site. Also, the signal paths through the radio transceiver - diplexer arrangement may be configured as described in the '312 Patent. However, in place of cables, connections between the diplexer and

the transceiver are effected by respective blind-mating RF connectors.

The diplexer's RF connectors are supported in a prescribed spatial orientation by a diplexer housing, that is adapted to be slidably insertable into the radio housing by way of a guide unit adjacent to the radio's transceiver. The guide unit may comprise a first set of guide elements (e.g., slots) configured to receive an associated set of guide elements (e.g. rails) of the diplexer support structure and thereby facilitate physical insertion and removal of the diplexer with respect the radio housing. To facilitate mutual connector alignment, the diplexer support housing may be keyed with respect to a diplexer reception cavity of the radio housing.

The transceiver is retained by a transceiver support structure containing a similar set of blind-mating RF connectors coupled to the transceiver's transmitter and receiver sections, respectively. The transceiver's RF connectors have the same spatial separation as, and interface genders complementary with those of the blind-mating RF connectors of the diplexer support structure. Insertion of the diplexer into the radio housing via the guide unit brings the diplexer's RF connectors into direct (blind-mating) physical and electrical engagement with the RF connectors of the transceiver. Once inserted, the diplexer may be securely retained in the radio housing by suitable fittings such as thumb screws.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 diagrammatically illustrates the architecture of a wireline-powered T1 radio of the type described in the above-referenced '370 application;

Figure 2 is a diagrammatic plan view of an embodiment of the cable-less blind-coupling, diplexer-to-transceiver interconnect arrangement of the present invention;

Figures 3 and 4 are respective diagrammatic plan and end views of a diplexer support structure; and

Figure 5 is a diagrammatic plan view of a non-limiting alternative layout topography of the radio housing of the present invention.

DETAILED DESCRIPTION

Before describing in detail the new and improved cable-less blind-coupling, diplexer-to-transceiver interconnect arrangement of the present invention, it should be observed that the invention resides primarily in modular arrangements of conventional wireless (radio) transceiver components, digital communication circuits, power supply and connector hardware components. In terms of a practical implementation that facilitates their manufacture and installation at a communication site having access to an existing digital signal transporting wireline cable plant, these modular arrangements may be readily configured using field programmable gate array (FPGA) and application specific integrated circuit (ASIC)

chip sets, and commercially available devices and components. As a consequence, the configurations of these arrangements and the manner in which they may be interfaced with an existing digital signal (T1) wireline link have been illustrated in readily understandable block diagram format, which shows only those specific details that are pertinent to the present invention, so as not to obscure the disclosure with details that are readily apparent to one skilled in the art having the benefit of present description.

Attention is now directed to Figure 2, which is a diagrammatic plan view of a first, non-limiting embodiment of the cable-less blind-coupling, diplexer-to-transceiver interconnect arrangement of the present invention. As in the radio of Figure 1, the radio contains a data pump 28 coupled with a transceiver 30, which includes a transmitter (Tx) section 31 that performs modulation and up-conversion of baseband signals (such as T1 data supplied from the data pump) to an FCC-conformal band RF signal (e.g., a 2-6 GHz spread spectrum signal), for application to the first transceiver port 41 of a diplexer 40. Similarly, in the receive direction, the transceiver 30 includes a receiver (Rx) section 32, wherein the received RF signal supplied from a second transceiver port 42 of the diplexer 40 is down-converted and demodulated to baseband for application to the data pump 28.

Like the radio architecture of Figure 1, the respective transmit and receive frequencies interfaced by a (type-N) connector 43 of the diplexer 40 with an antenna are selected by one of two complementary frequency plans, the other of which is employed by a companion radio at a remote site. Also, the signal paths through the radio transceiver - diplexer arrangement are preferably as described in the '312 Patent. However, rather than using respective sections of relatively fragile and lossy cable to connect one of the two diplexer ports 41/42 to the transmit port of the transceiver 30 and the other diplexer port 42/41 to the receive port of the transceiver 30, the two diplexer ports 41 and 42 are implemented by means of respective first and second blind-mating RF connectors 51 and 52.

As shown in the plan view of Figure 2 and the diagrammatic plan and end views of Figure 3 and 4, the diplexer's RF connectors 51 and 52 are supported in a prescribed spatial orientation by a diplexer support structure 50, such as a support chassis or housing, that is adapted to be slidably insertable into the radio housing 60 via a guide unit 70 thereof, that is adjacent to the transceiver 30. As a non-limiting example, the guide unit 70 may comprise a set of guide elements 71/72, such as slots and the like, that are configured to engage an associated set of guide elements 53/54, such as rails, tracks and the like of the diplexer support structure 50, and thereby facilitate physical insertion and removal of

the diplexer with respect the radio housing. To facilitate mutual connector alignment, the diplexer support housing 50 may be keyed with a guide slot 55 or the like, that is adapted to engage an associated guide rail, bar and the like (not shown), within a diplexer reception cavity of the radio housing.

The transceiver 30 is retained by a transceiver support structure that contains a similar set of first and blind-mating RF connectors 81 and 82, that are coupled to the transceiver's transmitter and receiver sections, respectively. The transceiver's RF connectors 81 and 82 have the same spatial separation as, and interface genders that are complementary to, those of the first and second blind-mating RF connectors 51 and 52 of the diplexer support structure 50. As a result, insertion of the diplexer 50 into the radio housing via the guide unit 70 will bring the diplexer's RF connectors 51 and 52 into direct (blind-mating) physical and electrical engagement with the RF connectors 81 and 82 of the transceiver. Once inserted, the diplexer 50 may be securely retained in the radio housing by suitable fittings 57, such as thumb screws and the like, that are sized to engage associated complementary elements, such as threaded bores in the radio housing.

It should be noted that the layout of the circuit board components within the radio housing is not limited to any particular geometry, such as the generally 'stacked' or sequentially 'cascaded' topography of the

plan view of Figure 2. As a non-limiting example, and as shown in the plan view of Figure 5, the radio's transceiver and data pump circuits may have a generally L-shaped layout within a generally rectangular housing, so as to accommodate the placement of the diplexer guide unit 70 at the 'bend of the L', and thereby provide a 'nested' component distribution within the radio housing.

As will be appreciated from the foregoing description, the problems associated with the use of lossy and relatively fragile sections of RF cable to connect a radio diplexer with an associated transceiver of a high band radio are effectively obviated by providing each of the radio transceiver and the diplexer with respective pairs of blind-mating RF transmission channel and receiver channel connectors, supported in a prescribed (fixed) spatial orientation that ensures blind-mating RF connectivity therebetween for either of two orientations and translation of the diplexer relative to the transceiver. With the elimination of the RF cable, that would require installation by a skilled technician during assembly of the radio, the customer is able to easily change the radio's frequency plan by simply removing, rotating and reinserting the diplexer.

While I have shown and described several embodiments in accordance with the present invention, it is to be understood that the same is not limited thereto but is susceptible to numerous changes and modifications as known to a person skilled in the art, and I therefore do

not wish to be limited to the details shown and described herein, but intend to cover all such changes and modifications as are obvious to one of ordinary skill in the art.